

413 ASPHALTIC CONCRETE (ASPHALT-RUBBER)

Asphalt-rubber asphaltic concrete (ARAC) is a dense graded hot mix similar to 406, 416, and 417, asphaltic concrete (AC), except the binder is Asphalt-Rubber instead of asphalt cement. Crumb rubber is blended with the asphalt cement to form the asphalt-rubber binder. The blending takes place in a reaction tank at temperatures between 350°F (175°C) and 400°F (205°C) for at least one hour. During this time, the rubber partially melts and is thoroughly mixed with the asphalt cement to form a binder material known as Crumb Rubber Asphalt or CRA.

Materials, testing procedures, and construction requirements are basically the same for the various types of asphaltic concrete pavement. For the sake of brevity, most inspection procedures can be found in the "Asphalt Concrete" section of this manual. This subsection of the manual contains additional inspection procedures and contract administration requirements for specification 413. Subsection 1009 (Asphalt Rubber Material) will also be useful.

413-3 Materials

413-3.02 Mineral Aggregate

Existing stockpiles can be used if satisfactory documentation, and testing, for uncompacted voids (ARIZ 247) can be provided by the Contractor. Samples should be taken so that the Department can perform verification testing. However, it is important to note that the use of existing stockpiles should be the exception, not the rule. The Project Supervisor needs to be in contact with the Contractor early on in the project to ensure that crushing is not performed without the Department's oversight.

Another important element of mineral aggregate production is the requirement that no individual stockpile shall have more than 6.0% passing the number 200 (75 μ m) sieve. This requirement provides the higher consistency in aggregate fines needed for asphalt-rubber. The Contractor may offer to adjust the feed rates from different cold feed bins to offset the effects of a dirtier (out of specification) stockpile. This is unacceptable. Even if the Contractor manages to keep the composite gradation within specifications, the resulting material will likely be near one of the gradation limits for the intermediate sieve sizes. This is not the intent of the specification, and is a violation of subsection 105.03. The intent is to provide a quality mineral aggregate for the pavement that is properly crushed and stockpiled.

413-3.03 Mineral Admixture

ARAC requires 1.0% mineral admixture to help prevent stripping. There are only two types allowed. The type will be stipulated in the mix design. The Portland cement, type II must be added as a dry powder to the mineral aggregate for mixing in the pugmill. Blended Hydraulic cement is not allowed. The lime must be hydrated and can be added as a dry powder or as a slurry (with water). Large chunks of mineral admixture are not allowed into the mix and the inspector should look for signs that these dry materials have been wetted during storage. There is another lime product called quicklime (CaO) that cannot be added to the mix. When CaO is mixed with water it is slaked (hydrated) which means the water is chemically combined with it. The hydrated lime called for in the specification has been slaked. It may still look like a dry powder, but there is some water combined in it. The inspector is made aware of these differences because CaO is dangerous to handle and if blended into the asphaltic concrete it will damage it.

413-3.04 Bituminous Material

The specifications for asphalt-rubber are found in Subsection 1009 of the Standard Specifications. Type B crumb rubber is the only type allowed for ARAC. Material properties, as well as mixing, temperature, storage, and certification requirements are all found in Subsection 1009.

The Contractors must submit an asphalt-rubber design showing the amount of rubber that will be blended with the asphalt cement. This must be done before a mix design can be developed.

413-4 Mix Design

Unlike AC, the Department's Pavement Materials Testing Section develops the mix design for ARAC. Some modified test procedures are used. However, a mix design cannot be performed until the Contractor does an asphalt-rubber design. It is important for the Project Supervisor or Resident Engineer to make the Contractor aware, as early on in the project as possible, of the need for an asphalt-rubber design.

The Resident Engineer is responsible for ensuring that the time periods for reviewing and verifying a mix design by the Department are strictly followed unless different arrangements are made in writing with the Contractor. Therefore, it is important that the Resident Engineer check with the acceptance lab to ensure that they can complete the verification testing within the prescribed time.

413-5 Mix Design Revisions

Occasionally, a revision to the mix design will be required to adjust for unanticipated or changing field conditions, or for a change in aggregate properties. When the change to a mix design is an adjustment to the asphalt-rubber content, then the Contractor is not entitled to any additional costs for operating the plant or equipment. If more asphalt-rubber is needed, the Department will pay for the material at a unit price below or at the contract unit price.

Cases where a Contractor is entitled to additional plant and operating costs include changes in the aggregate source, required changes in the asphalt-rubber properties, or changes in the aggregate properties themselves without changing sources. These are situations where the properties of the mix may change significantly enough to affect plant procedures and lay down or compaction methods.

413-6 Acceptance of Materials

It cannot be emphasized enough that ADOT field staff must closely monitor the crushing operation and stockpile production. Even though aggregate sampling and testing have been done during stockpile production, samples still need to be taken and tested from the cold feed during asphalt production. This serves as a final check to ensure the mineral aggregate will stay within acceptable tolerances for gradation, sand equivalence, and fractured coarse aggregate particles.

Asphalt-rubber content shall be checked at least four times a day using the Contractor's nuclear gage. See Subsection 414-6 of this manual for further information.

413-7 Construction Requirements

Please note that the requirements for incorporation of the mineral admixture into the mix are the same as for most other types of asphaltic concrete. Refer to the "Construction Requirements" subsection in "Asphalt

Concrete” section of this manual for further information and instructions.

The method in which the asphalt-rubber is introduced into the mix must be carefully inspected. On a typical batch mix or drum mix plant (refer to Exhibit AC-3), asphalt cement is stored in a storage tank, and a series of lines and pumps move the asphalt cement from the storage tank to the pugmill or drum mixer. There is an automatic feedback system that controls the amount of asphalt cement based on flow of mineral aggregate and admixture. When asphalt-rubber is used, a reaction tank is introduced between the asphalt cement storage tank and the pugmill or drum mixer. The reaction tank is used to blend together the asphalt cement and crumb rubber. The Inspector may discover a line leading directly from the reaction tank to the pugmill or drum mixer with no automated control system that regulates the flow of the asphalt-rubber based on the flow of the mineral aggregate and admixture. This type of set up is unacceptable to the Department. An automated control system needs to be in place for asphalt-rubber asphaltic concrete (ARAC) mixing just like it does for regular asphaltic concrete (AC) mixing. Do not allow the Contractor to manually control the addition of asphalt-rubber. This method is imprecise and prone to human error that will adversely affect the consistency of the mix produced by the plant. It is recommended that the Resident Engineer address this point at the pre-paving conference.

Another important difference in asphalt-rubber paving is that surfaces need to be tacked with asphalt cement; no cutbacks or emulsions are to be used. Although not harmful to asphalt-rubber, volatiles in asphalt-rubber can react with cutbacks and emulsions, so they will not bond as well as asphalt cement.

Specification 413 ARAC has strict air and surface temperature requirements that must be followed. There are two conditions. The first condition applies to start-up. Both the surface temperature and the air temperature must be at least 65°F (18°C), with the air temperature rising before paving can begin. The second relates to when paving must stop. In this case, if the air temperature is at or below 70°F (21°C) and falling, the paving must stop.

It is important to note that this second condition does not have a surface temperature requirement. The Contractor may argue that as long as the surface temperature is above 70°F (21°C), then it should be OK to continue paving, especially when it's acceptable to begin paving when the surface temperature is only 65°F (18°C). The Inspector should not accept this argument. A falling air temperature is a good indicator that the surface temperature is beginning to fall as well; there is lag time between the two. By the time the Contractor gets the plant shut down, all the asphalt placed and compacted that was delivered, the surface temperature will probably have dropped significantly. This is why the specification is based on a falling air temperature rather than a falling surface temperature.

Compaction requirements for ARAC are method specifications. Regardless of the lift thickness, the Contractor must follow a prescribed compaction procedure and rolling pattern. All compactors must be steel wheel (no rubber tires allowed), and for lifts greater than 1" (25 millimeters) two of the compactors must be vibratory. Inspectors are required to continually document the Contractor's rolling operation since there are no density requirements for the finished mat. Compaction acceptance is based on rolling pattern, not density.

The specifications require construction of a transverse construction joint if the paver is stopped for more than three minutes. This is to ensure that there is adequate time to place and compact the mix that is held in the laydown machine before the mix cools. Field personnel occasionally show some leniency in this regard for thicker lifts only, especially if weather conditions are favorable. It is suggested that the temperature of the mix in the laydown machine be closely monitored if paving is stopped for more than three minutes. Never allow an exception for thin ARAC lifts, or for AR-ACFC where the same language is found in subsection 414. Thinner lifts have more exposed surface area per volume than thicker lifts, so they will cool faster.

The Project Supervisor and Resident Engineer have some latitude in specifying how many rollers are required behind the laydown machine. Even if the production exceeds 250 tons per hour, engineering judgment may be used to determine if an additional roller is needed to obtain density.

ARAC is placed at a higher temperature than regular AC. This results in more pick-up by the steel wheel compactors. The specifications address this problem by requiring the compactor wheels to be wetted with water to prevent pick-up. Specifications also permit soapy water, or a product approved by the Resident Engineer. The Department discourages the use of lime water since it can't be sprayed in a fine mist. The high alkalinity of the lime tends to sterilize the surrounding soils and makes landscaping or re-vegetation more difficult later on.

Some other inspection points include:

1. Verify that the crumb rubber and asphalt cement have been in the reaction tank at 325°F to 375°F (163°C to 191°C) for at least one hour prior to use in the mix (see Subsection 1009).
2. Keep a daily count of the number of bags of crumb rubber used.
3. Asphalt-rubber that has been kept in the reaction tank for more than 10 hours above 325°F (163°C) should not be used. "Carry-over" must be cooled before the 10-hour time limit and then re-heated. The specifications only allow one re-heating cycle for any particular batch. In some cases, the Central Lab can test carry-over to see if it is still suitable. See Subsection 1009 of the Standard Specifications for further information.

For asphalt-rubber paving, the Department generally requires a full time Inspector at the plant to oversee the stockpiling and batching operations, including the blending of the asphalt-rubber. The Project Supervisor should carefully outline the duties of the Inspector at the plant so that the most effective use can be made of this person. Section 304 of the ADOT Training Manual for the Inspection of Bituminous Roadway Construction should serve as a guideline for assigning inspection duties.

413-8 & 9 Method of Measurement & Basis of Payment

The method of measurement and basis of payment for ARAC is similar to other AC except as follows;

1. Asphalt-rubber is measured and paid instead of asphalt cement.
2. Subsection 413-9 does not allow the 413-6.03(B) nuclear gauge test results to be used as a method of measurement for asphalt-rubber. Asphalt-rubber must be weight directly, or calculated from the weight of asphalt cement and crumb rubber used minus the waste.
3. There are no price adjustments for compaction since the acceptance is based on rolling pattern only.